Notes on the Opisthobranchs of the West Coast of North America

II. The Order Cephalaspidea from San Diego to Vancouver Island

BY

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In attempting to prepare a key to the species of the Order Cephalaspidea recorded from San Diego, California, to Vancouver Island, British Columbia, I have become increasingly aware that a key to these species, as they are now known, is not feasible at this time. However, it is possible to present a statement concerning the systematic problems existing in the Order Cephalaspidea, as it is known on this coast. I hope that such a statement, together with a species list, will stimulate the additional research necessary to resolve some, if not all, of these problems.

Although a number of cephalaspideans have been described from the area under consideration, virtually nothing is known of the anatomy of the animals. Many species are quite small and have been obtained alive only by dredging. The systematic arrangement which is presently in use by conchologists on the west coast is artificial in that it depends too heavily upon shell characters (e.g., see: Keen & Pearson, 1952; Burch, 1945a, 1945b; Keen, 1958). The shells of some species offer so few characters for positive identification that, without knowledge of the external and internal anatomy of the animals themselves, it is impossible to establish their systematic position at the familial or the subordinal level. Pilsbry (1895, 1896) was aware of this problem, and his keys to the families of the order, based upon the characteristics of the radula and the development of the parapodia, was a major step toward providing some rational system of classification for this group. Since then, the cephalaspideans have received much attention in Europe where they are well known (e.g., see: Pruvot-Fol, 1954).

Without knowledge of the soft parts of the animals, it is impossible to relate the systematic position of most of our cephalaspideans to those in other parts of the world. For that matter, until more information is obtained, the relationships between the species already described will be doubtful. Burch (1945a, 1945b) gives a good account of the problems involved in working with west coast species, and, although Oldroyd (1927) may be outdated for other groups of mollusks, her account of the cephalaspideans is still useful. Keen & Pearson's key (1952) is excellent for determining the generic position of the shells of this group as they are now known, and, as many species range from Southern California southward, Keen's later treatment of the group for tropical west America (1958) is also helpful.

The Order Cephalaspidea is divided into three suborders. The shell is external in the Suborders Bullacea and Scaphandracea; however, parapodia (upwardly directed lateral extensions of the foot) are present in the Suborder Scaphandracea but absent in the Suborder Bullacea. The shell is internal in the Suborder Philinacea. It is in the Suborders Bullacea and Scaphandracea that most of the systematic problems exist. For the placement of the families and genera discussed below, the reader is referred to the list of species at the end of this paper.

The Genus Microglyphis Dall, 1902, is usually placed in the Family Acteonidae (Suborder Bullacea). Acteonids possess an operculum, but Dall in his original description states that Microglyphis is inoperculate. The shells of Mi-

croglyphis are markedly similar to those of members of the Family Ringiculidae, a family which is closely allied to the Family Acteonidae. I have tentatively placed this genus in the Family Ringiculidae in the list at the end of the paper.

The Family Acteocinidae has been used, in the area under consideration, as a catch-all for species whose shells bear some resemblance to one another. It is usually composed of the following genera: Acteocina Gray, 1827; Coleophysis Fischer, 1883; Retusa Brown, 1827; Volvulella Newton, 1891; and Sulcoretusa Burch, 1945. Keen (1958) also includes Cylichna Lovén, 1846, and Cylichnella Gabb, 1873. However, when the entire organism is considered, Acteocina, Cylichna, and Cylichnella are genera usually assigned to the Family Scaphandridae, and a species of Retusa, R. trunculata (Bruguière, 1772), is the type of the Family Retusidae, the Family Scaphandridae being included in the Suborder Scaphandracea and the Family Retusidae in the Suborder Bullacea. Pruvot-Fol (1954) synonymizes Volvulella with Volvula A. Adams, 1850, and includes the latter genus in the Family Bullidae (Suborder Bullacea). Although the concept of what actually constitutes the Family Acteocinidae on our coast appears to be somewhat obscure, I have retained the family in the list, including in it, however, only the species assigned to Acteocina by previous workers and the following species of "Retusa".

Sulcoretusa is a name proposed for the preoccupied Sulcularia Dall, 1921, which was originally used as a "section" of the genus Retusa but was subsequently raised to generic rank (see Burch, 1945a). Two species, Retusa xystrum Dall, 1919, and R. (Sulcularia) montereyensis Smith & Gordon, 1948, must be considered here. If they are correctly placed in the Family Acteocinidae, then a change must be made in their generic placement. I have retained both species in the Family Acteocinidae in the list only for convenience, as I have no evidence to suggest that they would be better placed elsewhere at this time. It may be that the genus Retusa (Suborder Bullacea) is not represented on our coast by any of the presently known species of cephalaspideans.

Coleophysis was also used by Dall as a "section" of Retusa for R. harpa Dall, 1871, but Burch (1945a) gives it full generic standing and includes Acteocina carinata Carpenter, 1857, in this genus. I have retained A. carinata in the genus Acteocina in the list.

According to Jefferson Gonor (University of Washington; written communication, June 1961), Retusa harpa belongs to the Suborder Scaphandracea and appears to be similar to species in the genus Acteocina. I have retained this species in the Family Acteocinidae as "Retusa" harpa. Further work needs to be done before this species may be assigned to a genus in the Suborder Scaphandracea.

The genus Cylichna is correctly included by Burch (1945a) in the Family Scaphandridae, and he considers the Californian species of Cylichnella to be more correctly placed in Cylichna. I have placed all of the species of Cylichnella in Cylichna on Burch's authority. Gonor (written communication, June 1961) suggests that the two are probably synonyms. However, Burch (loc. cit.) also lists Diaphana Brown, 1827, in the Family Scaphandridae. A species of Diaphana, D. minuta Brown, 1827, is the type upon which the Family Diaphanidae is based. This family belongs to the Suborder Bullacea.

I have included Broctonia Iredale, 1915, represented in California by B. polystrigma (Dall, 1908), in the Family Scaphandridae only because Dall, in his original description, states that the shell resembles Cylichna. It may, however, belong to an entirely different family or even a different suborder.

The names Acteocina and Volvulella have been rejected by Marcus (1955) and Pruvot-Fol (1954), respectively, as being invalid for Recent genera because they have fossil forms as type species. Marcus gives an excellent discussion of the reasons for using the name Tornatina A. Adams, 1859, in preference to Acteocina. I agree with Marcus that it is not advisable to base a Recent genus upon a fossil form in cases where the anatomy of the animal is the primary means of identification; however, in order not to confuse the literature with name changes which may subsequently prove to be incorrect, I have retained the names Acteocina and Volvulella in the list.

Haminoea Turton & Kingston, 1830, is erroneously placed by our conchologists in the Family Akeridae (also spelled Aceridae). It actually belongs to the Family Atyidae. This family is included in the Suborder Scaphandracea.

Keen & Pearson (1952) place our Atys in the Family Scaphandridae so there may be some doubt as to which family our species of Atys may belong. I have included them in the Family

Atyidae.

Because of the confusion which exists in determining the exact placement of many members of the Suborders Scaphandracea and Bullacea and because the relationships between most of the species known on our coast have not been worked out satisfactorily, I have not attempted a thorough investigation of the individual species listed below. Until our species are more fully known, such an investigation would be both time consuming and relatively futile. The works which have been cited above, including those containing original descriptions of species, are included in the bibliography. In addition, the reader is referred to the works of Dall (1921) and Grant & Gale (1931).

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List of Species in the Order CEPHALASPIDEA
(San Diego to Vancouver Island)

CEPHALASPIDEA

Bullacea

ACTEONIDAE

Acteon painei DALL, 1903
Acteon punctocaelatus (CARPENTER, 1864)
Acteon traski STEARNS, 1898

RINGICULIDAE

Microglyphis breviculus DALL, 1902
Microglyphis estuarinus DALL, 1908

BULLIDAE

Bulla gouldiana (PILSBRY, 1893)
Bulla quoyana (DALL, 1919)
Volvulella californica DALL, 1919
Volvulella cooperi DALL, 1919
Volvulella cylindrica (CARPENTER, 1863)
Volvulella tenuissima WILLETT, 1944

RETUSIDAE

No known species within the range under consideration are definitely assignable to this family.

DIAPHANIDAE

Diaphana californica DALL, 1919

Scaphandracea

SCAPHANDRIDAE

Broctonia polystrigma (DALL, 1908)
Cylichna alba (BROWN, 1827)
Cylichna attonsa (CARPENTER, 1865)
Cylichna diegensis (DALL, 1919)

ACTEOCINIDAE

Acteocina carinata CARPENTER, 1857
Acteocina culcitella (GOULD, 1852)
Acteocina eximia (BAIRD, 1863)
Acteocina inculta (GOULD, 1856)
Acteocina infrequens (C. B. ADAMS, 1852)
Acteocina intermedia WILLETT, 1928
Acteocina magdalenensis DALL, 1919
Acteocina oldroydi DALL, 1925
Acteocina planata DALL, 1919
Acteocina smirna DALL, 1919
"Retusa" harpa DALL, 1871
"Retusa" montereyensis SMITH & GORDON, 1948
"Retusa" xystrum DALL, 1919

ATYIDAE

Atys casta CARPENTER, 1864
Atys nonscripta (A. ADAMS, 1850)
Haminoea olgae DALL, 1919
Haminoea vesicula GOULD, 1855
Haminoea virescens (SOWERBY, 1833)

Philinacea

PHILINIDAE

Philine alba MATTOX, 1958
Philine bakeri DALL, 1919
Philine californica WILLETT, 1944
Philine polaris AURIVILLIUS, 1885

GASTROPTERIDAE

Gastropteron cinereum DALL, 1925
Gastropteron pacificum BERGH, 1893

AGLAJIDAE

Aglaja adellae DALL, 1894
Aglaja diomedea (BERGH, 1894)
Aglaja nana STEINBERG & JONES, 1960
Aglaja ocelligera (BERGH, 1894)
Aglaja purpurea (BERGH, 1894)
Chelidonura phocae MARCUS, 1961
Navanax inermis (COOPER, 1862)

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Studies on Mollusk Populations
V. -- *Tegula rugosa* (A. Adams, 1853)

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(4 Textfigures)

Arthur Adams described Chlorostoma rugosum at the meeting of the Zoological Society of London under the date of May 27, 1851 (actually published in 1853) as follows:

"C. testâ turbinatâ, profundè umbilicatâ, luteo-fuscá, nigro variegatâ, longitudinaliter nodoso-plicatâ, transversim sulcatâ; anfractu ultimo rotundato, infra suturam angustato; columellâ incurvatâ, anticè bituberculatâ, tuberculo supremo magno, prominente; labro fusco marginato.
Hab. —?"

This brief description may be translated, somewhat freely, as follows:

'The shell of this Chlorostoma is top shaped, deeply umbilicate, yellowish brown with black markings, longitudinally with nodose folds and transversely with grooves; last whorl rounded, narrowed at the suture; columella incurved with two tubercles anteriorly, the upper of which is large and prominent; lip with brown margin.

'Habitat unknown.'

Fischer (1880) redescribed this same species in the large Iconograph of Kiener as Trochus rugosus, A. Adams:

"Trochus rugosus, A. Adams. *Testa anguste perforata, conoidea, crassa, rudis; anfractus 5-6, superne et plerumque erosi, oblique striati, sordide fusco-cinerei, fulvo obscure et radiatim flammulati, convexiusculi; ultimus tumidus, ad suturam late appressus, marginatus et irregulariter lamelloso-plicatus; spiraliter cingulatus, interdum radiatim subplicatus, infra convexus et concentrice, sulcis 6-7, apertura rhomboidea, nigro vel purpureo marginata; columella brevi, bidentata, dente superno majore; callo umbilicari perforationem partim tegente."*

This somewhat difficult description, in which important words seem to be missing, was accompanied by a more complete and comprehensive French description.